

Unified frame, system for transferring semiconductor wafers and related substrate objects, and system for transporting wafers

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Abstract of TW579564B

The present invention is a unified spine structure that EFEM components, such as a wafer handling robot and a SMIF pod advance assembly, may mount to. The frame includes multiple vertical struts that are mounted to an upper support member and a lower support member. Structurally tying the vertical struts to the support members creates a rigid body to support the EFEM components. The vertical struts also provide a common reference that the EFEM components may align with. This eliminates the need for each EFEM component to align with respect to each other. Thus, if one EFEM component is removed it will not affect the alignment and calibration of the remaining secured EFEM components. The unified frame also creates an isolated storage area for the SMIF pod door and the port door within the environment that is isolated from the outside ambient conditions.

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整合式的框架，用於傳輸半導體晶圓以及相關基板物件之系統以及傳送晶圓之系統

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摘要 本發明係關於一種可安裝有 EFEM 組件之整合式脊柱結構，EFEM 組件譬如為一晶圓處理機械臂及一 SMIF 艙前進組件。框架係包括安裝至一上支撐構件及一下支撐構件之多個垂直支架，藉由將垂直支架結構性束縛至支撐構件而產生一用於支撐 EFEM 組件之剛性體部。垂直支架亦提供可供 EFEM 對準之一共同參考，如此不再需令各 EFEM 組件彼此相對對準，因此，若移除一個 EFEM 組件將不會影響仍固定的 EFEM 組件之對準及校準。整合式框架亦在與外部大氣條件隔離的環境內創造對於 SMIF 艙門及埠門之一隔離的儲存區域。

- 申請專利範圍 1.一種可供安裝半導體前端組件之整合式的框架，該整合式的框架對於所有相對準的組件提供單一參考，包含：至少兩個垂直支架，各該垂直支架具有一上部、一下部、一前面及一後面：一上支撐構件，其固定至各該垂直支架的頂部；一下支撐構件，其固定至各該垂直支架的下部，該下支撐構件創造一固定至該前面之前安裝表面、及一固定至該後面之後安裝表面；及該等前端載入組件安裝至該等前與後安裝表面。
- 2.如申請專利範圍第 1 項之整合式的框架，其中該下支撐構件進一步創造位於該前安裝表面與該後安裝表面之間之一埠門/載體門儲存區域。
- 3.如申請專利範圍第 1 項之整合式的框架，其中該上支撐構件具有至少一個穿孔狀表面。
- 4.如申請專利範圍第 1 項之整合式的框架，其中該下支撐構件具有至少一個穿孔狀表面。
- 5.如申請專利範圍第 1 項之整合式的框架，其中各該垂直支架大致彼此平行。
- 6.一種可供安裝半導體前端組件之整合式的框架，該整合式的框架對於所有相對準的組件提

圓廠地板上方且由一支撑結構所支撐，所以在該系統與該晶圓廠地板底下之間存在一開放空間。

22.如申請專利範圍第 20 項之系統，其中該系統進一步包括安裝至該外部安裝表面之一控制盒。

23.一種用於傳送晶圓之系統，包含：至少一前端載入埠組件，其選自包括下列各物的群組：(i)一載入埠組件，(ii)一風扇/過濾單元，(iii)一晶圓處理機械臂，(iv)一 FOUP 對接/隔離板，及(v)一埠門組件；及一整合式的框架，其可供安裝該等前端載入組件，該框架創造用於精密地對準該等前端載入組件之單一參考，該整合式的框架係包括安裝至一上支撐構件及一下支撐構件之至少兩個垂直支架。

24.一種用於在一具有一載體門及一載體套的晶圓載體與一和外部大氣條件隔離的環境之間傳輸半導體晶圓及相關基板物件之系統，包含：一整合式的框架，其包括相隔並安裝至一下支撐構件及一上支撐構件之至少兩個垂直支架，該框架界定至少一 I/O 埠及一埠門/載體門儲存區域；一透明的載體對接/隔離板，其安裝至各該垂直支架；一載體前進組件，其安裝至該下支撐構件，該載體前進組件暴露於該等外部大氣條件；一埠門組件，其具有一埠門及一驅動機構，該驅動機構係用於在該 I/O 埠與該埠門/載體門儲存區域之間移動該埠門；及一晶圓處理機械臂，其位於該與外部大氣條件隔離之環境內，包括：--一線性驅動器，其安裝至該下支撐構件而具有沿一 x 軸線的線性動作；--一旋轉性驅動器，其安裝至該線性驅動器以繞一 θ 軸線旋轉；--一 z 軸線線性驅動器，其從該旋轉性驅動器延伸而具有沿一 z 軸線的線性動作，該 z 軸線與該 θ 軸線呈偏移且大致平行；及--一徑向驅動器，其可移除地安裝至該 z 軸線線性驅動器，並包括至少一端點效應器而具有沿一徑向軸線的線性動作。

25.一種用於在一 SMIF 艙與一和外部大氣條件隔離的環境之間傳輸半導體晶圓及相關基板之 EFEM 系統，包含：一整合式的框架，其具有安裝至一上支撐構件及一下支撐構件之至少兩個垂直支架，該框架界定一 I/O 埠；一晶圓引擎，其安裝至該下支撐構件，該晶圓引擎位於該和外部大氣條件隔離的環境內；一 SMIF 艙前進組件，其安裝至該下支撐構件，該艙前進組件暴露於該等外部大氣條件；一 SMIF 艙對接板，其安裝至各該垂直支架，該對接板暴露於該等外部大氣條件；及該整合式的框架的垂直支架係提供可供對準該晶圓引擎、該 SMIF 艙前進組件及該 SMIF 艙對接板之一共同參考。

26.如申請專利範圍第 25 項之系統，其中該晶圓引擎包括：一線性驅動器，其安裝至該下支撐構件，而具有沿一 x 軸線的線性動作；一旋轉性驅動器，其安裝至該線性驅動器以繞一 θ 軸線旋轉；一 z 軸線線性驅動器，其從該旋轉性驅動器延伸，而具有沿一 z 軸線的線性動作，該 z 軸線與該 θ 軸線呈偏移且大致平行；及一徑向驅動器，其可移除式安裝至該 z 軸線線性驅動器，並包括至少一端點效應器而具有沿一徑向軸線的線性動作。

27.如申請專利範圍第 25 項之系統，其中該 SMIF 艙對接板為透明狀。

圖式簡單說明：圖 1 為根據習知技藝的一習知前端組件之立體圖；圖 2 為圖 1 所示的前端組件之俯視圖；圖 3 為根據習知技藝的一習知前端組件之側視圖；圖 4 為根據本發明的脊柱結構之一實施例的立體圖；圖 5 為圖 4 所示的脊柱結構之部份分解圖；圖 6 為根據本發明之一 FOUP 對接介面的一實施例之立體圖；圖 7 為根據本發明之脊柱結構及前端載入組件的一實施例之部份分解立體圖；圖 8 為根據本發明安裝至脊柱結構之一晶圓引擎的一實施例之立體圖；圖 9 為根據本發明安裝至脊柱結構的一晶圓引擎驅動軌的一實施例之立體圖；圖 10 為根據本發明之前端載入介面的一實施例之側視圖；圖 11 為根據本發明之整合式微環境及結構的另一實施例之部份分解圖；圖 12 為圖 11 所示之整合式微環境及結構的側視圖；圖 13 為根據本發明之背骨結構的一實施例之部份立體圖；圖 14 為根據本發明之整合式微環境及結構的另一實施例之立體圖；圖 15 為圖 14 所示之整合式微環境及結構的端視圖；圖 16 為顯示圖 15 所示之整合式微環境及結構的整合式框架的一實施例之部份分解圖；圖 17A-17B，根據習知技藝，圖 17A 為一習知的晶圓處理機械臂的一實施例之俯視圖；圖 17B 為圖 17A 所示之晶圓處理機械臂具有伸長的端點效應器之俯視圖；圖 18 為根據本發明之一快速交換晶圓引擎的一實施例之立體圖；圖 19 為圖 18 所示之晶圓引擎的立體圖，其中顯示驅動器機構及垂直柱及滑體機構之數個組件；圖 20 為根據本發明之一晶圓引擎的另一實施例的立體

English Translation of
Cited Reference (1)

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Claims { Corresponding to US
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1. A unified frame that semiconductor front end components may mount to, the unified frame providing a single reference for all the components to align with, comprising:
 - 5 at least two vertical struts, each said vertical strut having an upper portion, a lower portion, a front face, and a rear face;
 - an upper support member secured to said top portion of each said vertical strut;
 - a lower support member secured to said lower portion of each said vertical strut, said lower support member creating a front mounting surface that is secured to said front face, and a rear mounting surface that is secured to said rear face; and
 - the front end load components mount to said front and rear mounting surface.
- 15 2. The unified frame as recited in claim 1, wherein said lower support member further creates a port door/carrier door storage area located between said front mounting surface and said rear mounting surface.
3. The unified frame as recited in claim 1, wherein said upper support member has at least one perforated surface.

4. The unified frame as recited in claim 1, wherein said lower support member has at least one perforated surface.
5. The unified frame as recited in claim 1, wherein each said vertical strut is substantially parallel to each other.
6. A unified frame that semiconductor front end components may mount to, the unified frame providing a single reference for all the components to align with, comprising:
 - at least two vertical struts, each said vertical strut having an upper portion, a lower portion, a front face, and a rear face;
 - an upper support member secured to said top portion of each said vertical strut;
 - a lower support member secured to said lower portion of each said vertical strut, said lower support member creating a front mounting surface that is secured to said front face; and
 - the front end load components mount to said front mounting surface of said lower support member and said rear face of said vertical strut.
7. The unified structure as recited in claim 6, wherein said upper support member has at least one perforated surface.

8. The unified structure as recited in claim 6, wherein said lower support member has at least one perforated surface.
9. The unified structure as recited in claim 6, wherein each said vertical strut is substantially parallel to each other.
- 5 10. A unified frame that semiconductor front end components may mount to, the unified frame providing a single reference for all the components to align with, comprising:
 - at least two vertical struts, each said vertical strut having an upper portion, a lower portion, a front face, and a rear face;
 - 10 an upper support member secured to said top portion of each said vertical strut;
 - a backbone support member secured to said rear face of each said vertical strut,
 - 15 a front mounting plate secured to said front face of each vertical strut; and
 - the front end load components mount to said front mounting plate and said backbone support member.

11. A unified frame that semiconductor front end components may mount to, the unified frame providing a single reference for all the components to align with, comprising:

5 at least two vertical struts, each said vertical strut having an upper portion, a lower portion, a front face, and a rear face;

a component mounting surface having an I/O port, said component mounting surface secured to said top and lower portion of each said vertical strut; and

10 the front end load components mount to said component mounting surface and said rear face of said vertical strut.

12. A unified frame that semiconductor front end components may mount to, the unified frame providing a single reference for all the components to align with, comprising:

15 at least two vertical struts, each said vertical strut having a first mounting surface, a second mounting surface, and a third mounting surface, said first, second, and third mounting surface being parallel to each other; and

the front end load components mount to at least one of said first, second, and third mounting surface of said vertical strut.

13. A system for transferring semiconductor wafers and related substrate objects between a wafer carrier having a carrier door and a carrier shell, and an environment isolated from outside ambient conditions, comprising:

5 a unified frame, including at least two vertical struts spaced apart and mounted to a lower support member and an upper support member, said frame defining at least one I/O port and a port door/carrier door storage area;

10 a carrier docking/isolation plate mounted to each said vertical strut;

a carrier advance assembly mounted to said lower support member, for supporting the wafer carrier, moving the wafer carrier towards said carrier docking/isolation plate, and moving the wafer carrier away from said carrier docking/isolation plate;

15 a port door assembly having a port door and a drive mechanism, said port door for engaging and mating with the carrier door, and said drive mechanism for moving said port door between said I/O port and said port door/carrier door storage area; and

a wafer handling robot mounted to said lower support member and positioned within the environment isolated from outside ambient conditions.

14. The system as recited in claim 13, wherein said vertical struts are substantially parallel to each other.

15. The system as recited in claim 13, wherein said carrier docking/isolation plate is removably mounted to each said vertical strut.

5 16. The system as recited in claim 15, wherein said carrier docking/isolation plate is transparent.

17. The system as recited in claim 13, wherein said port door/carrier door storage area has at least one perforated surface.

18. The system as recited in claim 13, wherein said wafer handling robot includes:

10 a linear drive mounted to said lower support member of said unified frame, having linear motion along an x axis;

 a rotational drive mounted to said linear drive, for rotating about a theta axis;

15 a z axis linear drive extending from said rotational drive, having linear motion along a z axis, said z-axis being offset and substantially parallel to said theta axis; and

a radial drive removably mounted to said z axis linear drive, including at least one end effector having linear motion along a radial axis.

19. The system as recited in claim 18, wherein said radial axis rotates about said theta axis when said rotational drive rotates.

5 20. A system for transferring semiconductor wafers and related substrate objects between a wafer carrier having a carrier door and a carrier shell, and an environment isolated from outside ambient conditions, comprising:

10 a unified frame having an interior mounting surface and an exterior mounting surface that front end load components mount to, said exterior mounting surface being exposed to ambient outside conditions, and said interior mounting surface being isolated from ambient outside conditions, said unified frame creating at least one I/O port and a carrier door/port door storage area;

15 a carrier advance assembly mounted to said exterior mounting surface;

 a carrier docking/isolation plate mounted to said exterior mounting surface;

 a wafer engine mounted to said interior mounting surface; and
 a port door assembly having a port door and a drive mechanism, said port door being slidably engaged with said unified frame, said drive mechanism for

moving said port door between said I/O port and said carrier door/port door storage area.

21. The system as recited in claim 20, wherein the system is mounted to a process tool such that the system is raised above the wafer fab floor and is supported by a support structure so that an open space underneath the system exists between the system and the wafer fab floor.

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22. The system as recited in claim 20, wherein the system further includes a control box mounted to said exterior mounting surface.

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23. A system for transporting wafers, comprising:

at least one front end load component selected from the group consisting of (i) a load port assembly, (ii) a fan/filter unit, (iii) a wafer handling robot, (iv) a FOUPE docking/isolation plate, and (v) a port door assembly; and a unified frame that said front end load components may mount to, said frame creating a single reference for precisely aligning said front end load components, said unified frame including at least two vertical struts mounted to an upper support member and a lower support member.

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24. A system for transferring semiconductor wafers and related substrate objects between a wafer carrier having a carrier door and a carrier shell, and an environment isolated from outside ambient conditions, comprising:

5 a unified frame, including at least two vertical struts spaced apart and mounted to a lower support member and an upper support member, said frame defining at least one I/O port and a port door/carrier door storage area;

 a transparent carrier docking/isolation plate mounted to each said vertical strut;

10 a carrier advance assembly mounted to said lower support member, said carrier advance assembly being exposed to said outside ambient conditions;

 a port door assembly having a port door and a drive mechanism, said drive mechanism for moving said port door between said I/O port and said port door/carrier door storage area; and

15 a wafer handling robot located within the environment isolated from outside ambient conditions, including:

 a linear drive mounted to said lower support member, having linear motion along an x axis;

 a rotational drive mounted to said linear drive, for rotating about a theta axis;

a z axis linear drive extending from said rotational drive, having linear motion along a z axis, said z-axis being offset and substantially parallel to said theta axis; and

5 a radial drive removably mounted to said z axis linear drive, including at least one end effector having linear motion along a radial axis.

25. An EFEM for transporting semiconductor wafers and related substrates between a SMIF pod and an environment that is isolated from outside ambient conditions, comprising:

10 a unified frame having at least two vertical struts mounted to an upper support member and a lower support member, said frame defining an I/O port;

a wafer engine mounted to said lower support member, said wafer engine being positioned within the environment that is isolated from outside ambient conditions;

15 a SMIF pod advance assembly mounted to said lower support member, said pod advance assembly being exposed to the outside ambient conditions;

a SMIF pod docking plate mounted to each said vertical strut, said docking plate being exposed to the outside ambient conditions; and

said vertical struts of said unified frame provide a common reference that said wafer engine, said SMIF pod advance assembly, and said SMIF pod docking plate may align with.

26. The system as recited in claim 25, wherein said wafer engine includes:

5 a linear drive mounted to said lower support member, having linear motion along an x axis;

 a rotational drive mounted to said linear drive, for rotating about a theta axis;

10 a z axis linear drive extending from said rotational drive, having linear motion along a z axis, said z-axis being offset and substantially parallel to said theta axis; and

 a radial drive removably mounted to said z axis linear drive, including at least one end effector having linear motion along a radial axis.

27. The system as recited in claim 25, wherein said SMIF pod docking plate is
15 transparent.

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